

Response Recommendations of last Machine Advisory Committee

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1. Vacuum and technical improvements
2. Polarization
3. pp luminosity

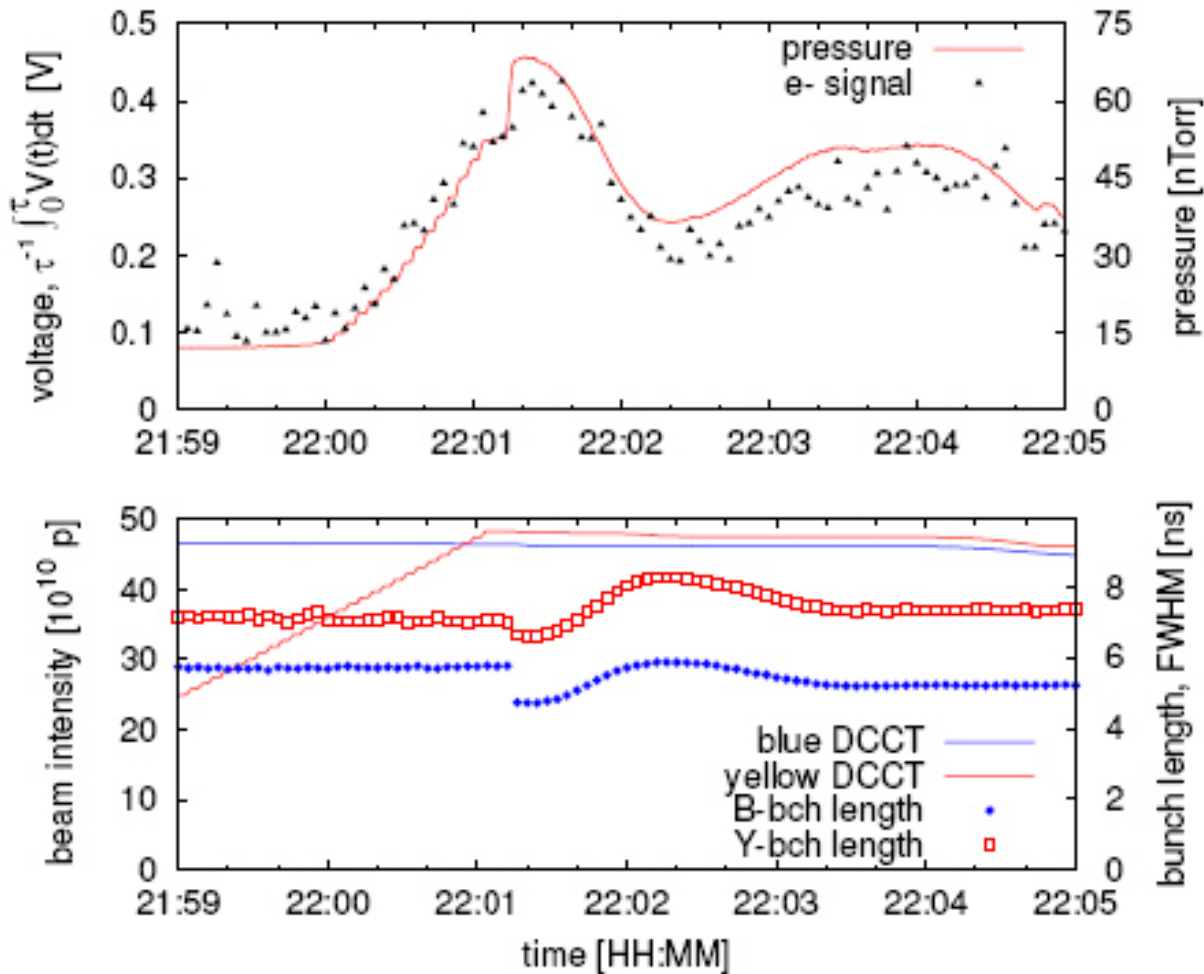
Vacuum limitations

“The committee therefore recommends pursuing the quest of ECI in luminosity operation and attempting to clarify this issue. The committee can see possible way of making further progress with this issue by measuring the coherent tune shift across the bunch train or additional effort to observe the electrons directly in the beam pipe. “

- Electron clouds were observed directly at store
- Final luminosity in Cu-Cu operation reached value predicted from vacuum limitations due to electron clouds

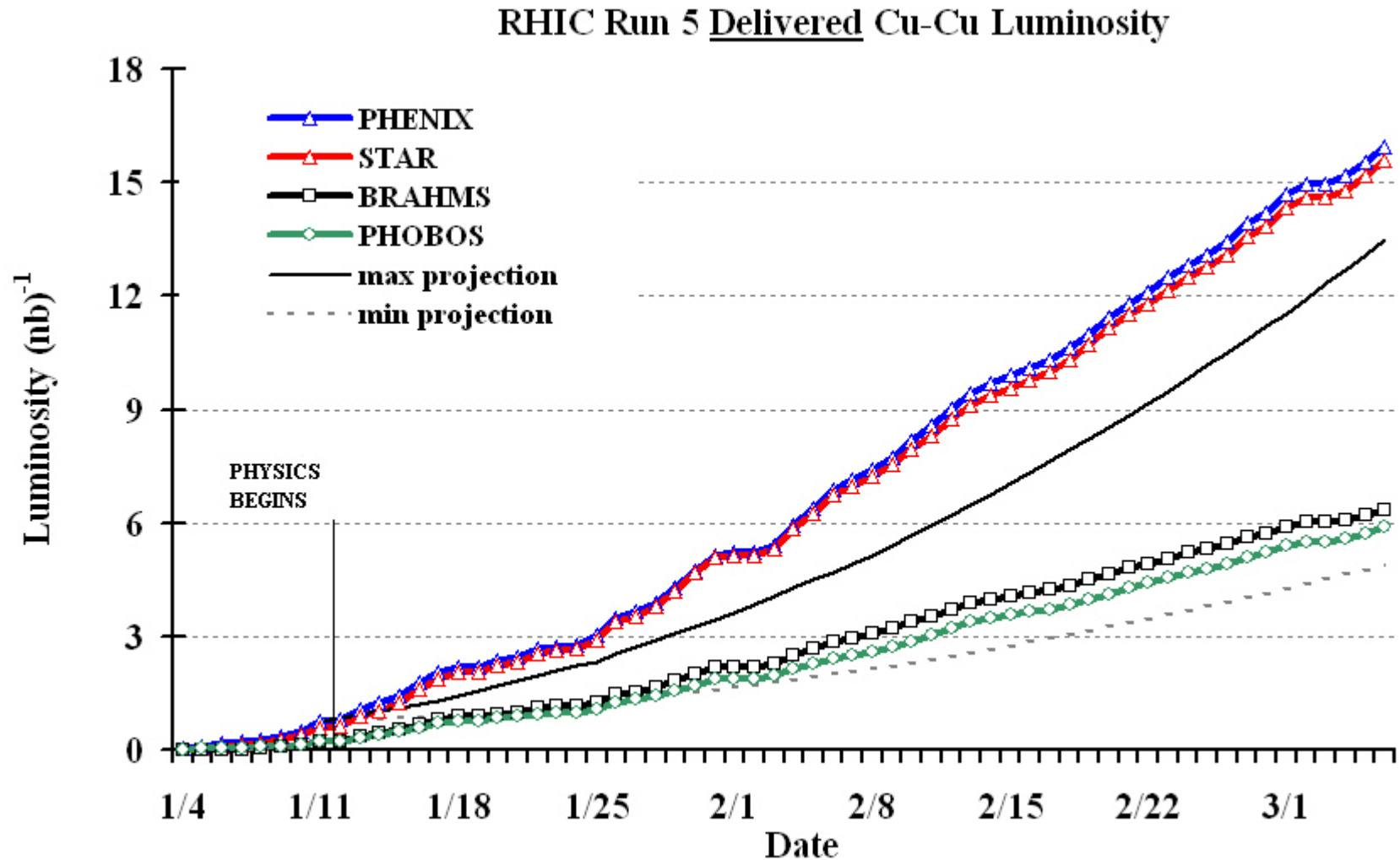
Electron and pressure rise

U. Iriso



**Clear connection
between e-cloud
and pressure
throughout ramp**
(Interaction Region 12)

Cu-Cu run predictions

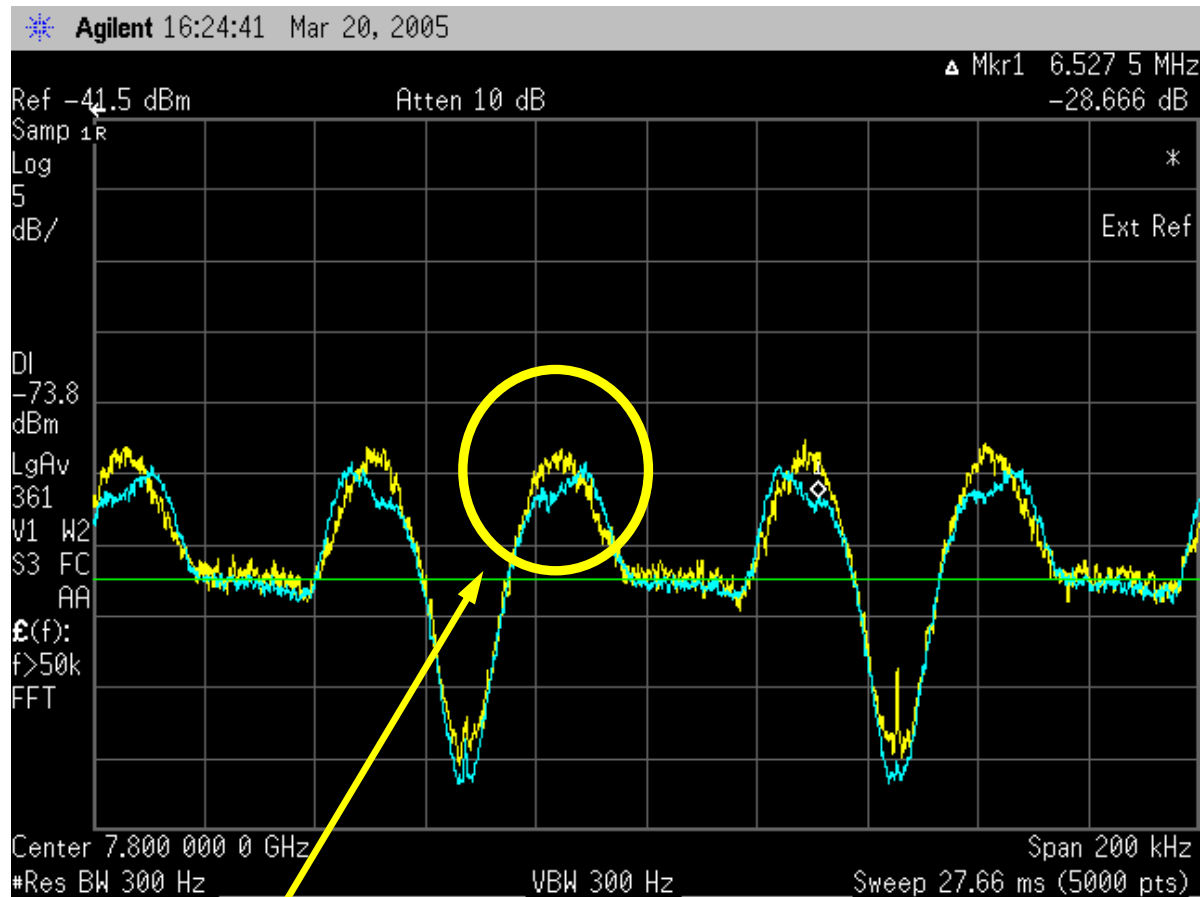


Stochastic cooling

“The committee therefore suggests investigating the possible benefit of a signal connection across the accelerator ring (“cutting a cord”) which would provide more margins in the achievable cooling rates and in addition would open the possibility to increase the bandwidth to 16GHz, which might be feasible.”

→ Has not been quantified yet.

Stochastic cooling



Signal suppression with Cu^{28+} ions
no cooling yet

Cold bore vacuum

“The committee endorses in particular plans to install additional turbo pumps around the accelerator in case that the improved sextant shows a better vacuum behaviour with respect to the rest of the ring. In case those additional pumps cannot be provided in time for the next shut down a staged cool down with concentration of the available pumping speed should be considered to be included in the shut down.”

- Initiated Accelerator Improvement Project (AIP) for cold bore vacuum.
- Installation of additional turbo and ion pumps in cold arcs
- Aim to reach average pressure of $1\text{e-}5$ Torr before cool-down
- Plan to warm up and cool down machine in Summer

New cold snake in the AGS

“The committee suggests that the polarization team performs a simulation of ramping with orbit and beta errors and realistic orbit correction in order to assess the operational difficulties and as a base for the planning of the necessary machine study time. Particular attention should be paid to non-linear depolarization resonances to avoid unpleasant surprises.”

- Lattice functions with several quadrupole correction schemes were explored in detail. A two-quadrupole scheme was selected and implemented. Commissioning showed adequate machine aperture at injection.
- Vertical tune was successfully placed to 8.97 during commissioning.
- New “horizontal depolarizing resonances” were identified with spin tracking. Could lead to depolarization when operating with strong partial snake.

Spin rotators at injection

“The committee would like to encourage the RHIC team to consider injection with both the Siberian snake and the rotator on in order to shorten the injection time, and hopefully increase the polarization transmission efficiency.”

→ This was tested during initial set-up for Run-5. Orbit excursions in the rotators was too large at injection energy.

RHIC orbit correction

“The committee believes that a condition of 250 GeV polarization will be stringent orbit control resulting in RMS orbit deviations from the centre of the quadrupole magnets of less than 0.3 mm. Such an almost planar orbit will require careful realignment of the accelerator magnets and will require beam based alignment techniques.”

- Run-5 showed that an orbit corrected to 0.5 mm RMS to the center of the quadrupoles is sufficient up to 100 GeV. An orbit that is corrected to be planar as determined from the survey data introduces high orbit harmonics due to the missing correctors in the defocusing quads and causes depolarization.
- 30 % polarization was observed at 205 GeV with an orbit corrected to about 0.5 mm RMS.

Simulation studies and accelerator study time

“The committee can see a considerable need for simulation studies and accelerator study time. The committee believes that good use of the time between now and 2008, when 250 GeV luminosity running is planned, needs to be made.”

- Beam development time to accelerate to 205 GeV was scheduled during Run-5. The main purpose was to determine the level of orbit correction that is required to avoid depolarization in preparation of a major machine alignment during summer 2005.
- Spin tracking studies and development of appropriate beam based alignment are ongoing.

RHIC polarimeter calibration

“The committee urges the polarimeter team to calibrate the polarimeters at 100 GeV/c. The uncertainty of this calibration has cast more uncertainties on the RHIC polarization effort more than necessarily, and should be resolved as soon as possible.”

- During Run-4 the calibration with the polarized hydrogen jet target reached a relative accuracy of 10%.
- The calibration during Run-5 should reach a relative accuracy of 5%.

Tune shift on ramp vs. resonance compensation

“The use of these tunes thus either requires to shift working points somewhere between injection and storage or to compensate for the strong 3rd integer resonances at injection. The committee suggests pursuing both options in order to maximize the possibility to be able to operate at the most favourable working point in collisions. “

- Tune shifting on ramp routine in operation
- No further work on 3rd order resonance compensation yet

Beam-beam studies

“The committee therefore suggests to keep up to study the RHIC beam-beam effects by both simulation and accelerator study in a systematic fashion to make a serious attempt to clarify the remaining difficulties. A number of obvious studies could be performed: The effect of modulation should be clarified by weak strong beam-beam simulations and by accelerator experiments. The RHIC team should investigate the emittance growth versus beam intensity over a wider range and investigate the role of working points experimentally.”

- No weak-strong simulations with modulations yet
- Emittance growth data available versus intensity from operations data
- Had tested a number of working points in Run-4

Fall back for luminosity – β^* reduction

“The committee is somewhat more sceptical whether the beam-beam problems can be resolved completely by the planned measures. The committee further suggests considering fall back positions in case the beam intensity can not be brought to the desired level. A possibility might be the reduction of beta function at the interaction point. This will most likely increase luminosity somewhat and might even reduce the residual orbit induced tune modulation. “

- More experience with reduced β^* from Cu-Cu (90cm vs. 1.0m in Run-4) and pp (first long run with $\beta^*=1.0\text{m}$ at 100GeV)
- Need better lattice understanding, not completely resolved